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THE HARRIMAN ALASKA EXPEDITION.

BY

HENRY GANNETT.

This expedition was in many respects unique. Mr. E. H. Harriman, the projector and patron, is a man well known in railroad circles. Though not a scientific man in the sense in which that word is commonly understood, he has a keen appreciation of the benefits of science to the world. In this spirit he conceived the idea of offering to a body of scientific men an opportunity of studying the little known coast of our Arctic province as his guests. Incidentally the expedition was so arranged as to afford an outing for himself and his family and a group of his personal friends.

The Washington Academy of Sciences, learning of this expedition, asked that it be carried out under its auspices, a proposition willingly agreed to by Mr. Harriman.

The nucleus of the party left New York City on May 23d, by special train for Seattle, Washington, where they arrived on May 31st, after a leisurely trip across the continent, in the course of which they visited Shoshone Falls in Idaho, and the lower cañon of Snake River, in northeastern Washington. On the way other members of the party joined the train, and in Seattle the personnel of the expedition was completed by the addition of several guests from the Pacific coast.

The following is a list of the scientific staff of the expedition:

Prof. Wm. H. Brewer, Yale University, New Haven, Conn.,
Botanist,
 Mr. John Burroughs, West Park, N. Y., Ornithologist,
 Dr. Westly R. Coe, Yale University, Anatomist,
 Mr. Leon J. Cole, Ann Arbor, Mich., Taxidermist,
 Mr. F. V. Coville, Dept. of Agriculture, Washington, D. C.,
Botanist,
 Mr. E. S. Curtis, Seattle, Wash., Photographer,
 Dr. W. H. Dall, U. S. Geological Survey, Washington, D. C.,
Paleontologist,
 Mr. Fred S. Dellenbaugh, Craigswood, N. Y., Artist,
 Mr. W. B. Devereux, Glenwood Springs, Colo., Mining Engineer,
 Prof. D. G. Elliot, Field Columbian Museum, Chicago, Ill.,
Zoologist,
 Prof. B. K. Emerson, Amherst College, Mass., Geologist,

Dr. B. E. Fernow, Cornell University, Ithaca, N. Y., Forester,
Dr. A. K. Fisher, U. S. Biological Survey, Washington, D. C.,
Zoologist,
Mr. L. A. Fuertes, Ithaca, N. Y., Bird Artist,
Mr. Henry Gannett, U. S. Geological Survey, Washington, D. C.,
Geographer,
Mr. R. Swain Gifford, New York, Artist,
Mr. G. K. Gilbert, U. S. Geological Survey, Washington, D. C.,
Geologist,
Mr. George Bird Grinnell, N. Y., Editor Forest and Stream,
Mr. Thos. H. Kearney, U. S. Dept. of Agriculture, Washington,
D. C., Botanist,
Mr. Chas. A. Keeler, Museum of California, San Francisco,
Ornithologist,
Mr. T. Kincaid, Seattle, Wash., Entomologist,
Dr. C. Hart Merriam, U. S. Biological Survey, Washington, D. C.,
Zoologist,
Mr. John Muir, Martinez, California, Glaciologist,
Dr. Chas. Palache, Harvard University, Cambridge, Mass.,
Geologist,
Mr. Robert Ridgway, National Museum, Washington, D. C.,
Ornithologist,
Prof. Wm. E. Ritter, Berkeley, California, Biologist,
Mr. De Alton Saunders, Brookings, S. D., Botanist,
Mr. E. C. Starks, U. S. Biological Survey, Washington, D. C.,
Taxidermist,
Dr. Wm. Trelease, St. Louis, Mo., Botanist.

Mr. Harriman's family and personal friends increased the party to fifty.

Immediately upon arrival at Seattle, the party was transferred on board the steamer *Geo. W. Elder*, which had been chartered for the expedition and completely overhauled and refitted. Everything requisite not only for the comfort of the party, but for the furtherance of scientific work was provided, not only for marine and shore work, but for travel in the interior, including men and animals, launches and other boats, tents and other articles of outfit.

Beyond making a visit to the Alaskan coast, no plans of work or of travel were made in advance. The party organized, however, immediately on coming together, with Mr. Harriman as chairman, appointed an executive committee, and committees on the various branches of science represented, such as geography, geology, zoology, botany, etc. The chairmen of the latter committees, with the captain of the ship, constituted a route committee—which decided, step by step, the route to be taken and the stops at points of interest. This plan worked admirably, both in the interest of scientific work and of harmony among the different interests involved.

The ship left Seattle on the afternoon of May 31. After a few hours' stop at Victoria on the following morning, she proceeded northwestward by the ordinary inside passage, through the fiords of British Columbia. Beyond a few landings of an hour or two, for botanical collections, no stop was made until Metlakatla, on Annette Island, was reached. Here the party remained a day to witness the excellent results of Dr. Duncan's labors among the Indians, which have resulted in changing them from a horde of cannibals to a self-respecting community. On the way north a few hours were spent at Wrangell, at Juneau, and on Douglas Island—to inspect the famous Treadwell mine, and the greatest stamp mills on earth. At Skagway, at the head of Lynn Canal, the ship waited a day, while the party were taken to the summit of White Pass by the railroad recently completed. Thence the party went to Glacier Bay, where several days were devoted to mapping and studying the glaciers both as to their geography and their influence upon plant and animal life.

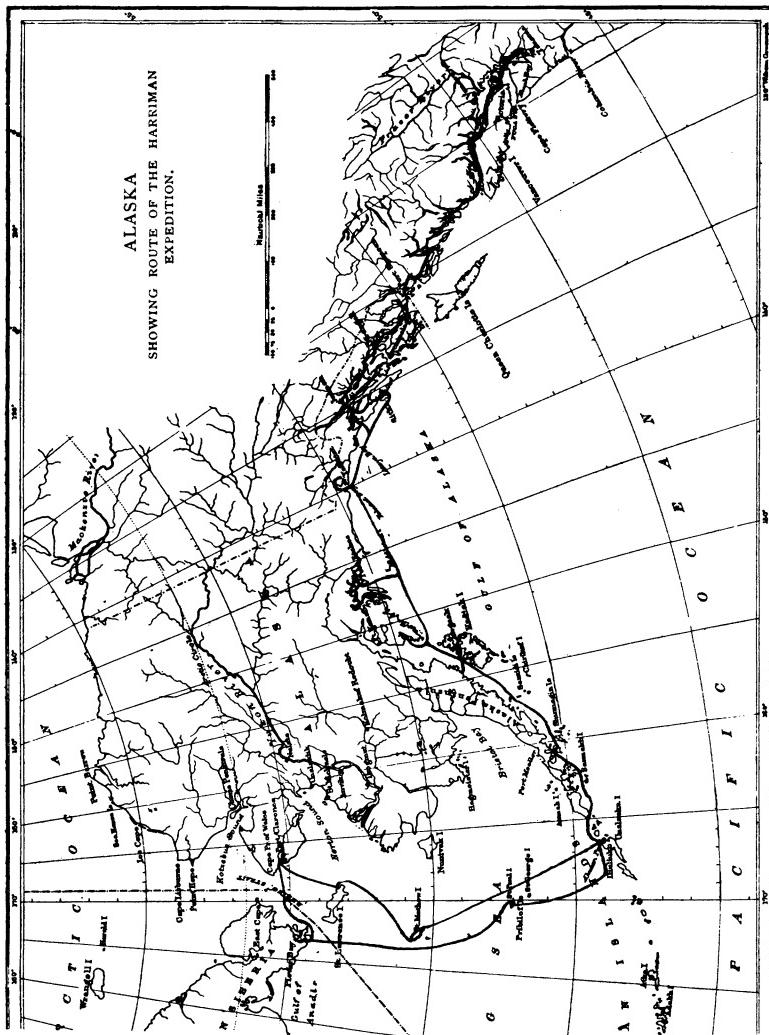
Thence the ship went to Sitka, and as this is an important type locality, several days were given to the biologists for collecting at this point. The boat then proceeded up the coast to Yakutat Bay, stopping a few hours on the way for the examination of Crillon Glacier, which drains an ice field on the southwest face of a portion of the Fairweather range.

At Yakutat, after landing hunting and biological parties on the shores of the bay, the boat went on up to its head, and finding it comparatively free of ice, swung around into Russell Fiord, as the extension above Malaspina's "Disenchantment Bay" has been named, and traversed it to its head, where anchor was dropped for the night. The *Geo. W. Elder* is the largest ship that has ever traversed this magnificent fiord, and only the second steamer that had ever entered it. On the return down the fiord, a party was left on shore for a few days, to map the glaciers which discharge into this and Yakutat Bay, including the Hubbard, probably the largest discharging glacier in North America, with a front of 5.2 miles, the Dalton, Hidden and Nunatak.

After picking up the scattered parties, on the shores of Yakutat Bay, the steamer went on to Prince William Sound—and here the work assumed more the character of exploration, as the region is little known to the chart or to scientific literature. The coast was found incorrectly mapped in many places, especially on the north and west sides of the sound. In one place a fiord, 15 miles in length and containing five discharging glaciers, was found, which

is not upon any map—while elsewhere scores of glaciers were found which were not of record. Here parties were landed, and several days devoted to their work.

The fjord above mentioned, which was named Harriman Fiord,



was mapped, with the glaciers tributary to it. Port Wells, of which Harriman Fiord is an arm, was also mapped, with six discharging glaciers, and many others which at present do not reach the sea.

A splendid glacier, called by the expedition Columbia, which

discharges into the head of a bay of the same name, was also mapped.

In the meantime, while the surveyors and geologists were occupied with glaciers, the biologists were busy enriching their collections. Altogether no locality visited by the expedition afforded as much material new to science as Prince William Sound.

Leaving Prince William Sound the ship proceeded to the north shore of Shelikof Strait, where a party of naturalists was landed, thence to Uyak Bay, on the north shore of Kadiak Island, where a party was given a chance to hunt for the great Kadiak bears, while the ship went to Kadiak, where she lay three days while the engines and compass were overhauled. These days were improved by geographers and naturalists in the neighborhood. On July 5 the ship started for Unalaska, picking up the shore parties on the way.

On the way to Unalaska the ship left a party of naturalists on Popof, one of the Shumagin islands, for an extended sojourn, and others were left at Unalaska. From this place a run was made to Bogoslof, two young volcanic islands in the southern part of Bering Sea. One of these came to the surface about 100 years ago, the other in 1884. The older of these islands is a favorite resting place for sea birds and a home for vast herds of sea lions. After a brief visit the ship's head was turned northward for St. Paul, the northernmost of the Pribilof Islands, the home of the fur seal. After visiting their harems, a long northward run was made to Plover Bay, in northeastern Siberia, just below Bering Strait. Here on a sand spit, in a glacial fiord, is a small village of Eskimos, the first of that people encountered. Thence the ship ran across to Port Clarence, Alaska, in Bering Strait. This was the most northern point reached. Indeed, it was practically as far north as the polar ice would permit the ship to reach, as it had not then retreated north of the strait. A fleet of steam whalers, 10 in number, was found here, waiting for the ice to clear in order to enable them to go north to the whaling grounds of the Arctic. Here all land at all level is tundra—a marsh of reindeer moss, interspersed with tussocks of grass, and at that season gay with flowers.

Starting southward from Port Clarence, the ship touched at St. Lawrence, Hall and St. Matthew Islands, in Bering Sea, which were found to be thronged with sea birds, who make these islands their breeding ground.

From Unalaska the ship went eastward over much the same route as on the outward journey, except that from Homer, in Kachemak

Bay, the course was laid direct for Yakutat Bay, passing south of Prince William Sound.

From Yakutat Bay a fine view was had of Mt. St. Elias and its neighbors, and the following day, which was wonderfully clear, the ship steamed all day along the base of the Fairweather range, with its great peaks, rising three miles into the air from the water's edge, alternating with great glaciers discharging bergs into the open sea.

Passing through Cross Sound and Icy Strait, the ship followed the inside passages back to Seattle, making but few stops, and arrived at the Washington metropolis on July 30th, having been away just two months. In that time the ship steamed nearly 9,000 miles, and no fewer than 50 stops were made, of greater or less length, in different localities.

The fronts of 23 glaciers were located, and most of these glaciers were mapped. The heights of many mountains, including the volcanic cones on the Alaska Peninsula and the Aleutian Islands were measured.

The weather throughout was kind, for Alaska. Although there were few cloudless days, there was little fog and rain, and that came, as a rule, when it could do little harm.

Most of the Alaskan coast visited by the *Geo. W. Elder* has been explored to the extent at least of mapping roughly the coast line. The explorations of the Russians, during their jurisdiction over the territory, supplemented by those of Dall under our Coast Survey, have made most of the coast line, with its intricate network of fiords and thousands of islands, fairly well known; still there remain many places where the coast line is unmapped, even roughly. The sea bottom, however, is by no means as well known, and in many localities there are no charts whatever showing soundings, so that navigation would be very perilous were it not for the fact that the coast is almost everywhere bluff and the water deep immediately off shore, with few reefs. Hence, navigation of most of the fiords, even those unsurveyed, is not suicidal, as there is little danger from shoals or submarine rocks.

The inshore topography, on the other hand, is very little known. Even in southeastern Alaska and its archipelago, whose shore line is accurately mapped, and whose waters are for the most part thoroughly sounded, little is known of the interior either of islands or mainland. On the mainland the Canadian Government has mapped certain areas lying within our jurisdiction, looking toward the settlement of the boundary question. The United States Coast Survey

has mapped a narrow fringe of topography, a fraction of a mile in width, along the coast. This, with a bit here and there from the Russian and later explorations, including the courses of a few rivers, sums up what we know of the interior near the coast.

The character of the trip was not such as to make possible any systematic exploration, either inland or even of the coast, since no extended stops were made. The most that it was possible to do was to make limited surveys in special localities which are of particular interest, and to measure heights of mountains. Thus many glaciers were surveyed, paying special attention to locating their fronts, for future comparison as to advance or retreat. The Harriman Fiord, in the northwestern part of Prince William Sound, was mapped, and an area of some 50 square miles in the neighborhood of Kadiak was surveyed.

But, besides these immediate contributions to the topography of Alaska, an excellent idea was obtained of the entire Alaskan coast, from Portland Canal to Unalaska.

The entire coast of Alaska and its islands, from Dixon Entrance to the Aleutian Islands, is mountainous. The land everywhere rises abruptly from the sea to summits ranging from 3,000 to 18,000 feet high. The mountain slopes are very steep, the higher summits are extremely rugged, and thousands of them are totally inaccessible. Level land near the coast is almost unknown, except at the heads of the fiords, which continue inland as valleys or cañons, with precipitous walls.

The most prominent fact connected with the coast region of southern Alaska, indeed of the northwest coast of North America, from Puget Sound to the end of the Alaskan peninsula, is that its features are almost wholly the product of glacial action. Not only are its fiords the abandoned channels of glaciers, but its hills and mountains were shaped by them, and so recent is the retreat of the glaciers that but little, if any, of the work of the atmosphere and of streams is thus far to be seen superimposed upon the glacial work. There is probably nowhere on earth an equal area in which the relief features are so purely the product of glacial erosion and in which aqueous erosion has done so little. The remains of the enormous glacial system which at one time covered practically this whole area are now existent in the form of hundreds of glaciers. While these are pygmies in comparison with their progenitors, scores of them exceed in magnitude the celebrated ones of Switzerland. Taken as a whole, the region is one affording unequalled facilities

for studying the work of glaciers, both in action and by their accomplished results.

The fiords present everywhere the characteristic cross-section of a glacier-cut gorge, with steep, almost precipitous walls, becoming gradually less steep toward the bottom, which is nearly level, giving the common U-shaped section. The floors of the gorges of branches are commonly at a higher level than the main fiord, so that they open upon it at altitudes of hundreds or even thousands of feet above it. This phenomenon, so nearly universal and so striking, has only recently been noted.

At the time these branch gorges were formed, the surface of the ice in them and in the main gorge was necessarily at the same level, and the difference in elevation of the floors of the gorges measured the difference in the thickness of the ice of the main and branch gorges. For if the surface of the ice in the branch were for any considerable time at a higher level than that of the main gorge, the former would cut its gorge down, so as to bring the surfaces on a level. It is furthermore manifest that the surface of the ice in the side gorge could not exist at a lower level than that of the main gorge, as in that case the latter would overflow into it. Hence the gorges of the main and branch glaciers represent a status which persisted for a long time, and the recession of the glacier must have been accomplished rather rapidly, as otherwise the branch would have had time to cut deeply into the wall of the main gorge.

On the Alaska coast are seen fine examples of these gorges in all stages, from those wherein the main and tributary gorges are both filled with moving ice, and the gorges are in process of formation, to those in which all the gorges, main and branch, have been abandoned by ice—and of these perhaps the most striking are those where the ice in the main gorge has retreated beyond the mouth of the tributary, which now descends in cascades of ice over the lip of the main gorge. Fine examples of this were seen in Russell Fiord, and in Port Wells, Prince William Sound, are several small glaciers formerly tributary to that in the head of the inlet, which are now cascading down the walls of the fiord into the water, from which the main glacier has retreated. The straightness of the fiords, the deflections in their courses produced by the junction with large branches, also stamp them unmistakably as glacier-cut.

There are no glaciers of magnitude on the islands of southeastern Alaska, although their relief forms were throughout carved by glaciers. The large living glaciers are confined to the mainland.

Glaciers exist in the mountains bordering the coast from Dixon

Entrance, westward, nearly to the end of the Alaska Peninsula, but, east of Glacier Bay, none of them descend to the sea, although many are of great magnitude, among them the Patterson, on Frederick Sound and the Davidson in Lynn Canal, both of which nearly reach the sea and doubtless not long ago were discharging icebergs into it. The existing glaciers of the Alaskan coast may be grouped in two classes, those whose fronts reach the sea, and discharge icebergs, and those which do not. The first may be called living, the latter dead. Of the former, the expedition saw and examined no fewer than 22, including 6 in Glacier Bay, the Muir, Grand Pacific, Johns Hopkins, Reid, Charpentier and Hugh Miller; The Crillon from the Fairweather range; 3 in Yakutat Bay and Russell Fiord, the Hubbard, Dalton and Nunatak; and 12 in Prince William Sound, including the Columbia in Columbia Bay, the Harvard, Yale, Smith, Bryn Mawr, Vassar and Wellesley in Port Wells, and the Harriman, Surprise, Serpentine, Cataract and Washington in Harriman Fiord.

Of the latter class, there are many hundreds, ranging in size from the Great Malaspina, a lake of ice 60 miles by 30, and fed by scores of ice streams from the St. Elias Alps, down to little streams flowing down the mountain gorges two or three miles only in length.

Among the many interesting questions propounded by the glaciers was that of their present movement, whether it be advance or recession. That in past times they have greatly receded, is shown by their abandoned channels, the fiords which make up the entire Alaskan coast and by the fiord-shaped valleys which characterize the inshore topography.

Examination of the neighborhood of existing glaciers shows that on the whole, they are, with few exceptions, still receding. This recession is probably not regular or continuous, since every winter shows an advance and every summer a recession, and since a year of heavy snowfall induces a temporary advance, while a hot or dry year produces an abnormally large recession; still all signs indicate, in the case of every glacier examined, with one exception, (the Crillon), that on the whole they are still retreating. The stretch of bare, naked land, both of valley and mountain slope, not yet covered with vegetation, extending outward from the glacier front, is in itself sufficient evidence of this retreat. In the case of Muir Glacier, which is the best known, the amount of recession has been directly measured, since the front of the glacier has been mapped at different times by Muir, Reid and Wright.

Here we find a recession of two miles in the past 20 years, and a reduction in the level of its surface of 300 feet in the same time.

The glaciers of Alaska take various forms. The simple form of a stream of ice flowing down a mountain gorge, with tributaries from neighboring gorges, is common. But the greater glaciers usually take the form of a lake of ice occupying a broad valley or a plateau, fed by streams of ice from the surrounding mountains, and drained by outlets in one, two or more directions. Of this type, the Muir is a fine example. It occupies a broad valley having a gentle slope to the south, east and west; is fed by streams from the mountains on the north, east and west, and has three outlets, by the Davidson Glacier to Lynn Canal, by a glacier to the west arm of Glacier Bay, while its largest outlet is by what is popularly known as Muir Glacier, southward, to Muir Inlet, a branch of Glacier Bay.

Of this type, too, are the great ice fields on either side of the Fairweather range, that on the northeast being drained into Glacier Bay by several outlets, and those on the southwest side discharging directly into the Pacific. On the shores of Prince William Sound are many examples of this type, great fields of ice in the interior, discharging at the coast by comparatively narrow outlets.

A third type is that illustrated by the great Malaspina Glacier, the king of all the Alaskan glaciers, a lake of ice, lying on a gentle slope open to the sea. The Malaspina is fed by many streams of ice from the St. Elias Alps, spreading out into this great lake, which wastes away mainly by melting, since only a small part of its front of 60 miles reaches the sea and discharges bergs. In places the surface of this great ice lake is covered with soil and supports a rank growth of vegetation. Here are flowers in profusion, and forests of spruce growing above the ice.

Russell Fiord is an extension of Yakutat Bay, which turns southward, abruptly back on itself and runs in that course some 25 miles, nearly to the sea. Indeed, it is separated from the sea only by a strip of low glacial deposit, some ten miles in width. In the high country to the east are great lakes of ice, with outlets to the fiord, and the head of Yakutat Bay. The greatest of these is the Hubbard Glacier, whose ice-front, at the head of the bay, is 5.2 miles in length, and keeps the bay filled with floating ice. When visited by Malaspina a century ago the upper end of Yakutat Bay was found to be closed by a glacier (Hubbard Glacier), which extended across it from side to side. Malaspina had entered Yakutat Bay in the hope and expectation of finding here the long-sought Northwest

Passage, and, in his disappointment, he named the upper part of this bay, Disenchantment.

At that time, Russell Fiord was a lake with its level about 200 feet above the sea. Its outlet was southward to the Pacific or westward to the foot of Yakutat Bay. Still earlier it was the path of a superb glacier, a portion of the Hubbard and others, which carved the present magnificent fiord.

When visited by Russell in 1892, the front of the Hubbard Glacier had retreated very nearly to its present position, opening up the fiord above which he explored and to it applied the name Disenchantment Bay, thus extending the application of the name to a feature to which Malaspina did not apply it. It seems best to restore the name to the head of Yakutat Bay, as given by Malaspina, and, to the fiord above no name is more appropriate than that of Russell, who discovered and explored it.

Prince William Sound was found to be a very fertile field for exploration, as even the coast line has been very imperfectly mapped. Here were found and mapped no fewer than twelve discharging glaciers, besides a much larger number which do not reach the sea. Here were found fiords, extending many miles inland, whose existence was unknown even to people living in the neighborhood.

At the head of a bay on the north coast of the sound was found a magnificent glacier, heading a beautiful bay into which it discharges bergs. Both bay and glacier were named Columbia. On the northwest coast of the sound is Port Wells, represented on the charts as a shallow bay. In fact it penetrates the land northward to a distance of 40 miles. Near its head it divides and at the head of each branch is a great glacier. The eastern one has been named Yale and the western Harvard. Along the west shore of the fiord is a series of short, steep glaciers, flowing down over the precipitous walls of the fiord, in cataracts of ice. Formerly, when the Harvard Glacier extended ten miles farther down the fiord, these were among its tributaries. They have been named as follows, in order downward, "Smith," "Bryn Mawr," "Vassar," "Wellesley."

At a point about 20 miles above the mouth of Port Wells, it is joined by a large western branch. As one steams up this branch it is apparently closed at a point about five miles above its mouth by the front of a large glacier, entering it from the north. As a matter of fact, the glacier does nearly close the fiord, stretching into it $1\frac{1}{2}$ miles and leaving a strait only half a mile wide between the point of ice and that of the land opposite. Doubtless but a few score of years have elapsed since the channel was closed by the glacier.

So far as we know, we were the first to pass through this strait,

“The first that ever burst
Into that silent sea,”

for, passing through the strait, we saw before us a magnificent fiord, 15 miles in length, trending a little west of south, and fairly lined with beautiful glaciers. It was in the arctic twilight that we passed the portals of this scene, and creeping cautiously through this utterly unknown water, it was nearly midnight when we turned in front of the ice-wall of the terminal glacier at the head of the fiord.

I spent the next few days ashore in camp, engaged in mapping this fiord, while the ship returned to Orca for some trifling repairs. The fiord and its terminal glacier have been named “Harriman” after our expedition. The next large glacier below the head, on the west side, has been christened “Surprise,” and the next “Serpentine,” while the large one which nearly closed the entrance, has received the name “Washington.”

The coast of Alaska is covered with forests, from Portland Canal nearly to the island of Kadiak, except in the neighborhood of retreating glaciers, where the land has not been released from its icy burden sufficiently long to cover itself with trees. The timber line runs low, ranging from about 3,000 feet in the southeast nearly to the sea-level in Prince William Sound. The Alaskan peninsula and the Aleutian Islands are treeless and are covered with grasses, willows and alder, as are the islands of Bering Sea, the Alaskan coast near Port Clarence and the Siberian coast opposite. In these northern climes all land at all level is tundra, constantly frozen below the surface, marshy and covered with reindeer moss, with tussocks of grass.

In the timbered region the trees are mainly Sitka spruce, with some cedar in the east and westward and upward, changing into hemlock. The latter is the prevalent tree at the timber limit.

The forests are by no means as valuable as in west Washington either in species or in size or density of trees. Their average diameter is certainly not more than two feet, and specimens double that diameter are not common. Most of the lumber used in Wrangell, Sitka, Juneau and Skagway, is brought from Puget Sound, not that Alaskan timber is valueless, but at present prices the Sound timber is more desirable.